CLAIMS

1. A roll pump within an enclosed region comprising:

a first solution-collection region;

a solution chamber, in communication with the first solution-collection region, in which solution is held within the chamber by capillary action;

a second solution-collection region in communication with the solution chamber; and

a solution-return surface on which solution moves from the second solution-collection region to the first solution-collection region.

2. The roll pump of claim 1 wherein the enclosed region is formed from a molded pocket and a cover strip.

3. The roll pump of claim 2 wherein the first solution-collection region and the second solution-collection region are formed from, and joined by, and inclined ramp, the first solution-collection region comprising a deep well at a first side of the enclosed region, and the second solution-collection region comprising a shallow well at a second side of the enclosed region.

4. The roll pump of claim 1 wherein, as the enclosed region is rotated about a rotation axis, solution migrates from the first solution-collection region into the solution chamber, from the solution chamber into the second solution-collection region, and from the second solution-collection region along the solution-return surface to the first solution-collection region.

5. The roll pump of claim 1 wherein the solution-return surface is an inner surface of the top of the enclosed region.

6. The roll pump of claim 1 wherein the enclosed region is a reaction chamber.

7. The roll pump of claim 6 wherein the reaction chamber encloses a reactive entity.

8. The roll pump of claim 7 wherein a gap between the lower surface of the reactive entity and an inner, bottom surface of the reaction chamber comprises the solution chamber.

9. The roll pump of claim 7 wherein the reactive entity is a microarray.

10. A roll pump incorporated within an enclosed reaction chamber, the roll pump comprising:

a first well near a first side of the reaction chamber, the first side of the reaction chamber substantially parallel with a rotation axis about which the reaction chamber is rotated;

a gap between a lower surface of a reactive entity enclosed within the reaction chamber and an inner, bottom surface of the reaction chamber maintained by positioning features within the reaction chamber; and

a gap along an inner surface of a top wall of the reaction chamber, the first well, the gap between the lower surface of the reactive entity and the inner, bottom surface of the reaction chamber, and the gap along the inner surface of the top wall of the reaction chamber forming a continuous, enclosed volume around the reactive entity through which solution circulates as the reaction chamber is rotated about the rotation axis.

11. The roll pump of claim 10 further including a second well, near a second side of the reaction chamber, the second side of the reaction chamber substantially parallel with a rotation axis about which the reaction chamber is rotated.

12. The roll pump of claim 11 wherein sides of the first well and the second well are formed from, and interconnected by, an inclined ramp, and wherein the first well is deeper than the second well.

13. The roll pump of claim 11 wherein the first and second wells are located near an edge of the reaction chamber perpendicular to the rotation axis.

14. The roll pump of claim 11 including a third well and a fourth well, the third well near the first side of the reaction chamber and the fourth well near the second side of the reaction chamber.

15. The roll pump of claim 14 wherein sides of the first well and the second well are formed from, and interconnected by, a first inclined ramp, wherein the first well is deeper than the second well, wherein sides of the third well and the fourth well are formed from, and interconnected by, a second inclined ramp, and wherein the third well is deeper than the fourth well.

16. The roll pump of claim 15 wherein, as the reaction chamber is rotated from an initial, horizontal position, droplets of the solution move from the first and third wells into solution residing in the gap between the lower surface of the reactive entity and the inner, bottom surface of the reaction chamber, from the solution residing in the gap between the lower surface of the reactive entity and the inner, bottom surface of the reaction chamber to the second and fourth wells, from the second and fourth wells to the inner surface of the top wall of the reaction chamber, and along the inner surface of the top wall of the reaction chamber to the first and third wells.

17. The roll pump of claim 11 wherein, as the reaction chamber is rotated from an initial, horizontal position, a droplet of the solution move from the first well into solution residing in the gap between the lower surface of the reactive entity and the inner, bottom surface of the reaction chamber, from the solution residing in the gap between the lower surface of the reactive entity and the inner, bottom surface of the reaction chamber to the second well, from the second well to the inner surface of the top wall of the reaction chamber, and along the inner surface of the top wall of the reaction chamber to the first well.

18. A roll pump incorporated within an enclosed reaction chamber containing a microarray, the roll pump comprising:

a deep well at a first side of the reaction chamber substantially parallel with a rotation axis about which the reaction chamber is rotated;

a shallow well at a second side of the reaction chamber substantially parallel with the rotation axis;

a gap between an active surface of the microarray and an inner, bottom surface of the reaction chamber maintained by positioning features within the reaction chamber;

a gap along an inner surface of a top wall of the reaction chamber, the deep well, shallow well, the gap between the active surface of the microarray and the inner, bottom surface of the reaction chamber, and the gap along the inner surface of the top wall of the reaction chamber forming a continuous, enclosed volume around the microarray through which solution circulates as the reaction chamber is rotated about the rotation axis.

19. The roll pump of claim 18 incorporated into a reaction chamber of a microarray strip, the reaction chamber formed by bonding of a pocket strip containing a pocket with array positioning features, the deep well, and the shallow well, to a cover strip.

20. The roll pump of claim 19 wherein the shallow well and deep well are formed from, and interconnected by, an inclined gutter ramp.

21. The roll pump of claim 19 wherein, as the reaction chamber is rotated about the rotation axis, solution moves from the deep well into the gap between the active surface of the microarray and the inner, bottom surface of the reaction chamber, from the gap between the active surface of the microarray and the inner, bottom surface of the reaction chamber to the shallow well, and from the shallow well along the inner top surface of the reaction chamber to the deep well.

22. The roll pump of claim 19 further including a second deep well and a second shallow well.

23. A method for circulating and mixing solution within a reaction chamber, the method comprising:

providing a first well near a first side of the reaction chamber, the first side parallel to a rotation axis about which the reaction chamber is rotated;

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positioning a reactive entity within the reaction chamber so that there are is a gap between a lower surface of the reactive entity and an inner, bottom surface of the reaction chamber and a gap along an inner surface of the top wall of the reaction chamber, the gap between the lower surface of the reactive entity and the inner, bottom surface of the reaction chamber, the gap along the inner surface of the top wall of the reaction chamber, and the first well forming a continuous volume around the reactive entity;

introducing solution into the first well and gap between the lower surface of the reactive entity and the inner, bottom surface of the reaction chamber; and

rotating the reaction chamber so that solution moves from the first well into the gap between the lower surface of the reactive entity and the inner, bottom surface of the reaction chamber, from the gap between the lower surface of the reactive entity and the inner, bottom surface of the reaction chamber to a second side of the reaction chamber parallel with the rotation axis, and from the second side of the reaction chamber along the inner top surface of the reaction chamber to the first well.

24. The method of claim 23 further including providing a second well near the second side, into which solution moves from the gap between the lower surface of the reactive entity and the inner, bottom surface of the reaction chamber and from which solution moves along the inner top surface of the reaction chamber to the first well as the reaction chamber is rotated.

25. The method of claim 24 further including providing a third well near the first side and a fourth well near the second side.

26. The method of claim 25 further including providing two inclined ramps, one that interconnects the first and second wells, and another that interconnects the third and fourth wells, the inclined ramps at opposite edges of the reaction chamber perpendicular to the axis of rotation.

27. The method of claim 23 wherein the reactive entity is a microarray.

28. The method of claim 23 wherein the solution is a hybridization solution.